PATENT SPECIFICATION (11) 1 388 473

1 388 473

(21) Application No. 3728/72 (22) Filed 26 Jan. 1972 (19)

(31) Convention Application No. 2 104 690

(32) Filed 2 Feb. 1971 in

(33) Germany (DT)

(44) Complete Specification published 26 March 1975

(51) INT. CL.[2] B01D 29/20 F16L 9/12

(52) Index at acceptance

B1D 1B1 1B2 2J1B1 2J1C3

B5A 1R14C2 1R14D 1R29X 1R32 1R60 2E4A 2E4B 2E4H

F2P 1A18A 1A24 1A27 1A28B 1B3 1B7 2A3

(54) FILTER TUBES

(71) We, KANSTSTOFFVERARBEITUNG AND SCHREINEREI Dipl.Ing. Adolf Voss, of 5789 Brunskappel, Germany, a German Company, O.H.G, do hereby declare the

invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The invention relates to filters particularly in the form of tubes which are made of a synthetic resin reinforced with fibres, for example glass fibres, and which are particularly suitable for use in fountains or wells. The filter tube generally comprises a plurality of members which extend in spaced relation between webs to form a screw, the spaces between the members forming filter slots.

Filter tubes of this kind are disclosed in the Applicants' German Gebrauchsmuster Specification No. 6,752,305. The free ends of known filter tubes are provided with connecting collars, for example for screw threads. For this reason, the known filter tubes can only be produced in moulds, and the lengths of the tubes manufactured thus have to correspond to the length of the available moulds. The manufacture of filter tubes in a number of sizes in keeping with different requirements thus requires the provision of a large number of costly moulds the manufacture and stock keeping of which increase substantially the costs of the filter tubes.

It is an object of the invention to provide a filter tube which may be produced in any desired length at little expenditure for the moulds.

According to the invention there is provided a filter tube of circular cross-section made of a synthetic resin reinforced with fibres, comprising a plurality of members disposed in a screw line and spaced apart in the axial direction of the tube by filter slots, the members extending between webs connected thereto which webs extend longitudinally of the filter tube, the interior of the filter tube having a screw thread which thread has the same screw line as the member along the whole length thereof.

Sections of any length may be cut off from the filter tubes embodying the invention. The sections may then be readily interconnected by means of threaded nipples the threaded extensions of which may be screwed into the internal threads of the filter tube sections. Continuous filter tubes of any length may thus be formed which may then be altered to suit the local installation conditions, this being impossible when the known filter tubes are used.

The fibre reinforcement of the filter tube may comprise several layers of slivers or strands of fibres extending helically along the whole length of the filter tube and other layers of slivers or strands of fibres which extend longitudinally of the filter tube in the webs, the lastmentioned layers laying in such manner that only one layer thereof is between two adjacent extending layers of slivers or strand of layers of the firstmentioned layers.

The inner layers of the longitudinally fibres may be directed inwardly. The strength of the turns of the internal threads may thus be considerably increased, since the deflected slivers suitably extend in substantially the same direction as the forces acting upon the thread.

According to a second aspect of the invention there is provided apparatus when used for the manufacture of filter tubes as hereinbefore defined, comprising a mandrel having an external thread corresponding to the internal thread of the filter tube to be produced, which external thread has a rib, interrupted by circumferentially disposed

clearances, extending longitudinally along the periphery of the thread.

In the manufacture of the filter tube from a homogeneous mixture of synthetic resin and fibres, the pulpy or pasty mixture, preferably several layers thereof, may be applied uniformly to the mandrel on which it remains until it has hardened, whereupon the finished filter tube may be removed from the mandrel.

Where a filter tube is produced in a casting mould, the mandrel constitutes the central, removable core of that mould.

According to a third aspect of the invention there is provided a method of making filter tubes as hereinbefore defined with the mandrel as hereinbefore defined comprising laying synthetic-resin impregnated layers of slivers or strands of fibres into the external thread of the mandrel and laying alternately with said layers other layers of slivers or strands of fibres through the series of clearances provided in the rib on the external thread of the mandrel so that they extend longitudinally of the mandrel, and holding all the longitudinally extending layers of slivers or strands of fibres in position as they are laid by a holding thread which is wound between the turns of the thread of the mandrel. As the holding thread is wound, its tension is adjusted so that the internal layers of the longitudinally extending layers of slivers or strands of fibres held in position thereby may be directed inwardly between the turns of the mandrel.

The removal of the finished filter tubes from the mandrel is facilitated by the construction of the mandrel, which preferably has an annular cross-section and may comprise a plurality of sections resting on a common central support and held in position by external retaining rings and a lock nut. The flanks of at least one of the sections and the adjacent flanks of the two adjacent sections extend in parallel relation, whilst the adjacent flanks of the other sections may suitably diverge in the shape of the letter "V" in the direction of the centre of the mandrel.

Apparatus suitable for the mechanical manufacture of the filter tubes by means of a mandrel of the kind hereinbefore described may comprise a machine frame with a headstock and a tailstock between the centres of which the mandrel is mounted for rotation and longitudinal slide support driven by a lead-screw which longitudinal slide support carries a supply spool for the layers of slivers or strands of fibres to be wound into the thread of the mandrel, and an annular slide support driven by a second lead-screw and guided on the mandrel, the annular slide support carrying supply spools for the layers of slivers or strands of fibres to be laid in the series of clearances provided in the longitudinal rib and a rotatable ring carrying a supply spool for a textile holding thread, the pitch of the second lead-screw and the rotational speed of the ring being adjusted so that during the rectilinear feed movement of the annular slide support the ring and the holding-thread spool mounted thereon perform a spiral movement the pitch of which corresponds to the pitch of the thread of the mandrel.

A filter tube, and apparatus for the manufacture thereof, embodying the invention are diagrammatically illustrated, by way of example, in the accompanying drawings, in which:—

Figure 1 shows a longitudinal section along the line I-I of Figure 2 through the filter tube;

Figure 2 shows a cross-section of the filter tube along the line II-II of Figure 1;

Figure 3 shows, on an enlarged scale, a longitudinal section of one of webs of the filter tube, which is reinforced, along the line I-I of Figure 2;

Figure 4 shows, on an enlarged scale, a longitudinal section through members of the reinforced filter tube along the line I-I of Figure 2;

Figure 5 shows the left-hand side, as viewed in Figure 8, of a longitudinal section of a mandrel for producing the longitudinal section shown in Figure 3, taken along the line V-V of Figure 8;

Figure 6 shows, also along the line V-V of Figure 8, the right-hand side, as viewed in the Figure 8, of the longitudinal section of the mandrel for producing the longitudinal section illustrated in Figure 4;

Figure 7 shows a longitudinal sectional elevation of the mandrel;

Figure 8 shows a transverse section through the mandrel along the line VIII-VIII of Figure 7; and

Figure 9 shows a diagrammatic representation of the apparatus, which uses the mandrel shown in Figures 7 and 8.

Referring to Figures 1 and 2, a filter tube 1 made of a synthetic resin such as a polyester resin, reinforced by fibres, for example glass fibres, comprises a plurality of members 2 disposed in a screw line.

The members 2, which are spaced apart in the axial direction to form filter slots 3, extend between webs 4 spaced at identical angular distances apart. There is a continuous thread 5 in the interior of the filter tube along the whole length thereof, by which thread 5 tube sections may be easily interconnected by means of threaded nipples 6 to form filter tubes of any desired length.

The fibre reinforcement of the filter tube comprises several layers 7, 8, 9 and 10

(Figure 3) of slivers or strands of fibres extending helically along the whole length of the filter tube. Other layers 11, 12, 13 of slivers or strands of fibres extend in the webs 4. Only single layers 11, 12 and 13 extend between respectively two adjacent layers of slivers 7 and 8; 8 and 9; and 9 and 10. It will be noted from Figure 3 that the internal (with respect to the tube interior) layers 11 and 12 of the slivers passing through the webs 4 are directed inwardly from the rectilinear direction of the web into the turns of the internal thread 5.

A mandrel 15 (Figures 5, 6, 7 and 8) is used for manufacturing the filter tube. The mandrel 15 is of annular cross-section and comprises three or more sections 16, 17, 18 resting on a common central support 19 and held in position by external retaining or locking rings 20 and 20′, one of which rings 20′ is fastened on the support while the other 20 is movable and pressed against the sections by a nut 21. Journals 22 and 22′ by means of which the mandrel is mounted, are provided on the support 19. As illustrated in Figure 8, adjacent flanks of one section 16 and of the two adjacent sections 17 and 18 extend in parallel relation. The adjacent flanks of the sections 17 and 18, which contact each other at the periphery only, diverge inwardly, that is towards the shaft 19, in the form of the letter "V" (Figure 8). An external thread 23, having the profile shown on an enlarged scale in Figures 5 and 6 is formed in the periphery of the mandrel 15. The profile of the external thread 23 matches the profile of the internal thread to be produced in the filter tube and has a rib 24 which extends along its turns, the thickness of which rib 24 corresponds to the width of the filter slots 3 to be formed. On each turn of the thread 23, the rib 24 has a number of circumferentially-disposed clearances or interruptions 25, 26 and 27 corresponding to the number of webs 4 to be produced, several rows of such clearance being spaced at identical angular distances apart along the length of the external thread of the mandrel.

The filter tube illustrated in Figures 3 and 4 consisting of a synthetic resin reinforced with glass-fibre slivers is produced by the following method:—

A synthetic resin-impregnated layer of glass-fibre slivers 7, initially wound into the external thread 23 of the mandrel 15, is covered with synthetic resin-impregnated layer of slivers 11 laid in the longitudinal direction of the mandrel into the series of clearances 25, 26 and 27. As they are in tied to the layer of slivers 7 by means of a process of being laid, the layer 11 is firmly textile holding thread 14 which follows the turns of the external thread 23 as it is wound around the mandrel. The tension of the holding thread 14 during the winding operation is adjusted so that, as indicated in Figure 3, the layer of slivers 11 is directed radially into the turns of the external thread 23. Similarly, further layers, 8, 12′, 14′, 9, 13, 14″, etc., are applied to the mandrel. The rib 24 extending along the external thread 23 produces the spaces between the developing member 2 which spaces form the slots 3 of the filter. The resin-impregnated layers of slivers then are allowed to harden, and when the finished filter tube on the mandrel 15 has hardened, the ring nut 21 is released so that the support 19 can be withdrawn, whereupon the mandrel section 16 provided with parallel flanks is moved initially radially inwards and then out of the filter tube in the axial direction. The space in the filter tube thus gained facilitates the removal of the other two sections 17 and 18 of the mandrel from the filter tube.

In connection with the apparatus shown in Figure 9, the mandrel 15 hereinbefore described is suitable for the mechanical manufacture of filter tubes provided with glass-fibre sliver reinforcement of the kind shown in Figures 3 and 4. In this construction, the mandrel 15 is rotatable and is mounted in centres between a fixed headstock 28 and a longitudinally displaceable tailstock 29 in a machine frame similar to a lathe, and is driven by an eccentric 30 provided on the headstock spindle. The layers of slivers 7 to 10 (Figure 3) are wound between the turns of the external thread 23 of the mandrel 15 by a longitudinal by movable slide rest support 31 carrying a supply spool 32 for the layers of slivers 7 to 10 and guided axially parallel with the mandrel. The slide support 31 is driven by a lead screw 43 according to the pitch of the thread 23 of the mandrel. An annular slide support 33, by which the mandrel is encircled, is provided in addition to the aforementioned longitudinal by movable slide support 31. The annular slide support 33 guided on the mandrel is reciprocated by the headstock 28 through a lead screw 34. The supply spools 35 and the guide pulleys 36 for the layers of slivers 11, 12, 13 to be inserted into the clearances 25, 26, 27 are spaced apart on the annular slide support 33 at similar angular distances to the distances between the clearances 25, 26, 27 in the rib 24 provided on the mandrel. The annular slide support carries, in addition, an external ring 37, which is preferably mounted on a ball bearing race, and on which the supply spool 38 of the holding thread 14, 14′, 14″ is mounted. In addi-

tion to feeding the annular slide support in the axial direction of the mandrel, the lead screw 34 has the further purpose of rotating the external ring 37. For this reason, the lead screw 34 is rotated by the headstock 28 and guided in a fixed nut 39 provided on the headstock by which the longitudinal movement of the lead screw 34 and the longitudinal movement of the annular slide support are produced. The rotation of the lead screw 34 is transmitted to the external ring 37 by a gear 40 through a gear rim or ring gear 41. The pitch of the lead screw 34 and the rotational speed of the external ring are adjusted so that the latter and the spool 38 of the holding thread mounted thereon carry out a thread movement the pitch of which corresponds to the pitch of the thread 23 of the mandrel, during the rectilinear feed movement of the annular slide support. The drives for the mandrel and the longitudinal slide support 31 on the one hand, and the drive on the annular slide support 33 and ring 37, on the other, may be started alternately. An extension provided on the mandrel 15 constitutes a supporting journal 42 of the headstock 28, on which journal 42, which has the same diameter as the mandrel 15, the annular slide support 33 assumes its inoperative position.

The spiral winding of the layers of slivers 7 to 10 into the turns of the mandrel thread 23 and between the turns of the rib 24 is effected by the rotating mandrel 15 with the aid of the longitudinal slide support 31 and the supply spool 32 mounted thereon. The annular slide support 33 is then in its inoperative position on the journal 42, in which position it clears the whole length of the mandrel. When one of the aforementioned layers of slivers has been wound into the thread of the mandrel, the mandrel is stopped in an angular position relative to the annular slide support 33 so that the series of clearances 25 to 27 in the rib 24 are in alignment with the spools 35 of slivers and with the guide pulleys 36 of the annular slide support 33. The annular slide support is then moved to the tailstock end of the mandrel 15 and switched to feed in the direction of the arrow *a* with the result that one layer 11, 12 or 13 at a time is laid across the layer of slivers, previously wound by the longitudinal slide rest 31, into the series of clearances 25 to 27 in the rib 24 and tied firmly in position by the holding thread 14, 14′ and 14″ wound by the rotating external ring 37 and the supply spool 38 provided thereon around the mandrel 15, the pitch of the turns of the winding corresponding to the pitch of the thread of the mandrel between the turns of which the turns of the holding thread extend.

When the annular slide support 33 is in the left-hand inoperative position, the finished filter tubes may be readily removed from the apparatus by shifting the tailstock 29 together with the mandrel 15, whereupon the filter tubes may be stored in order to allow the synthetic-resin impregnation to harden. The removal of the finished filter tubes from the mandrel has been described previously with reference to Figures 7 and 8.

WHAT WE CLAIM IS:—

1. A filter tube of circular cross-section made of a synthetic resin reinforced with fibres, comprising a plurality of members disposed in a screw line and spaced apart in the axial direction of the tube by filter slots, the members extending between webs connected thereto which webs extend longitudinally of the filter tube, the interior of the filter tube having a screw thread along the whole length thereof which has this same screw line as the members.

2. A filter tube according to claim 1, in which the fibre reinforcement comprises several layers of slivers or strands of fibres extending helically along the whole length of the filter tube and other layers of slivers or strands or fibres which extend longitudinally of the filter tube in the webs, the last-mentioned layers laying in such manner that only one layer thereof is between two adjacent layers of the first mentioned layers.

3. A filter tube according to claim 2, in which inner layers of the longitudinally extending layers of slivers or strands of inner fibres are directed inwardly.

4. Apparatus when used for the manufacture of the filter tubes according to any one of the preceding claims, comprising a mandrel having an external thread corresponding to the internal thread of the filter tube to be produced, which external thread has a rib, interrupted by circumferentially disposed clearances, extending longitudinally along the periphery of the thread.

5. Apparatus according to claim 4, in which the mandrel is of annular cross-section and comprises a plurality of sections mounted on a common central support and held in position by external retaining or locking rings and a tightening nut, the flanks of at least one of the sections and the adjacent flanks of the two adjacent sections extending in parallel relation, and the adjacent flanks of the other sections diverging to form an aperture of "V" section in the direction towards the longitudinal axis of the mandrel.

6. A method of manufacturing the filter tube according to any one of claims 1 to 3 with the mandrel according to either of claims 4 and 5, comprising laying synthetic resin-impregnated layers of slivers or strands of fibres into the external thread of the mandrel and laying alternately with said layers other layers of slivers or strands of fibres through the series of clearances provided in the rib on the external thread of the mandrel so that they extend longitudinally of the mandrel and holding all the longitudinally extending layers of slivers or strands of fibres in position as they are laid by a holding thread which is wound between the turns of the thread of the mandrel.

7. A method according to claim 6, in which as the holding thread is wound, its tension is adjusted so that the internal layers of the longitudinally extending layers of slivers or strands of fibres held in position thereby are directed inwardly between the turns of the thread of the mandrel.

8. Apparatus when used for the mechanical manufacture of filter tubes according to anyone of claims 1 to 3 using the mandrel according to either of claims 4 and 5, comprising a machine frame having a headstock and a tailstock between the centres of which the mandrel is mounted for rotation, and a longitudinal slide support driven by a lead screw, which longitudinal slide support carries a supply spool for layers of slivers or strands of fibres to be wound into the thread of the mandrel, there being an annular slide support driven by a second lead screw and guided on the mandrel, which annular slide support carries supply spools for layers of slivers or strands of fibres to be laid in the series of clearances provided in the longitudinal rib, and a rotatable ring carrying a supply spool for a textile holding thread, the pitch of the second lead screw and the rotational speed of the ring being adjusted so that, during the rectilinear feed movement of the annular slide support, the pitch of the spiral movement performed by the external ring and consequently also by the spool of the holding thread mounted thereon, corresponds to the pitch of the thread of the mandrel.

9. A filter tube having an internal thread, substantially as hereinbefore described with reference to and as shown in Figures 1 to 4 of the accompanying drawings.

10. A method of manufacturing a filter tube with an internal thread, substantially as hereinbefore described with reference to and as shown in the accompanying drawings.

11. Apparatus when used for producing a filter tube with an internal thread, substantially as hereinbefore described with reference to and as shown in Figure 7 to Figure 9 of the accompanying drawings.

EDWARD EVANS & CO.,
53-64 Chancery Lane,
London, WC2A 1SD.
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1975.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY
from which copies may be obtained.

1388473 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

SHEET 1

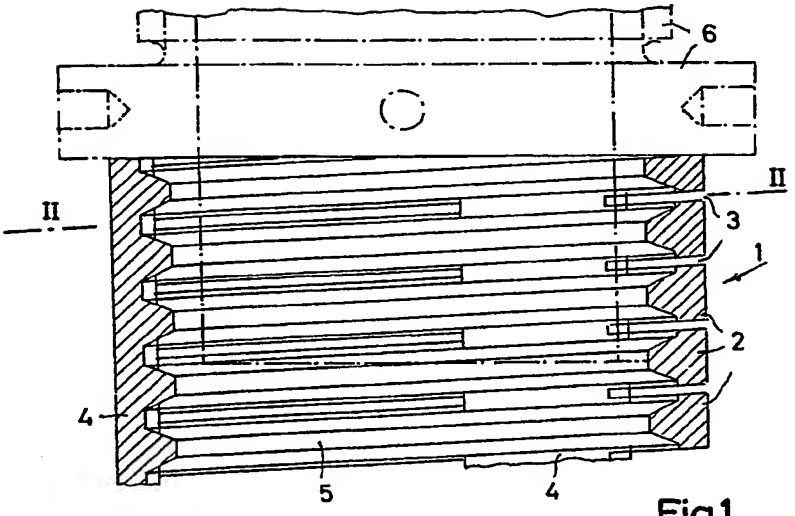

Fig1

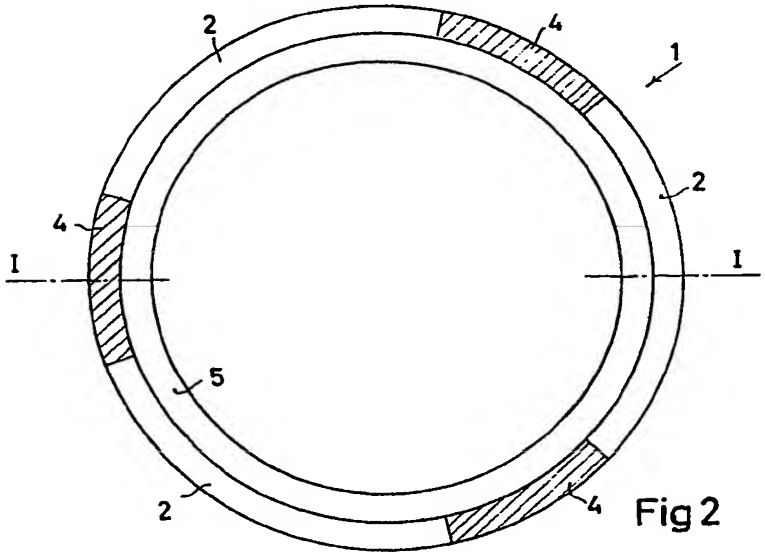

Fig 2

1388473 COMPLETE SPECIFICATION

3 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

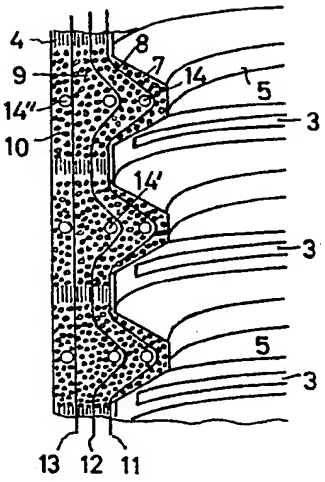

Fig 3

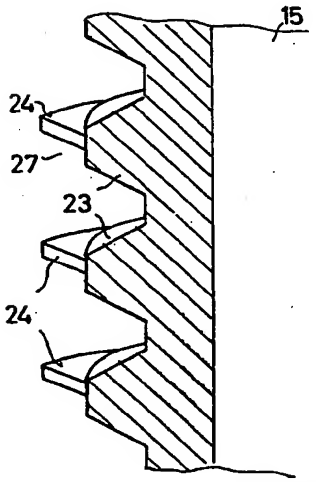

Fig5

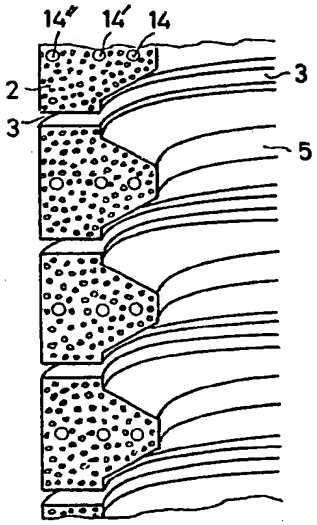

Fig4

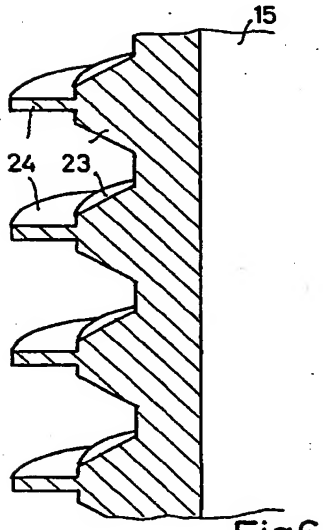

Fig6

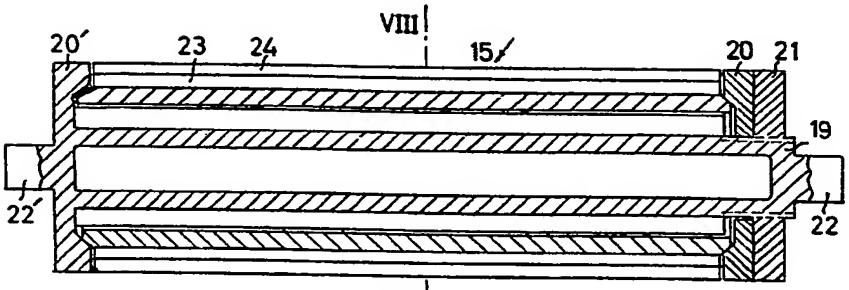

Fig7

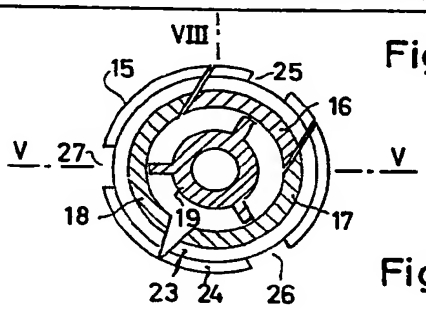

Fig8

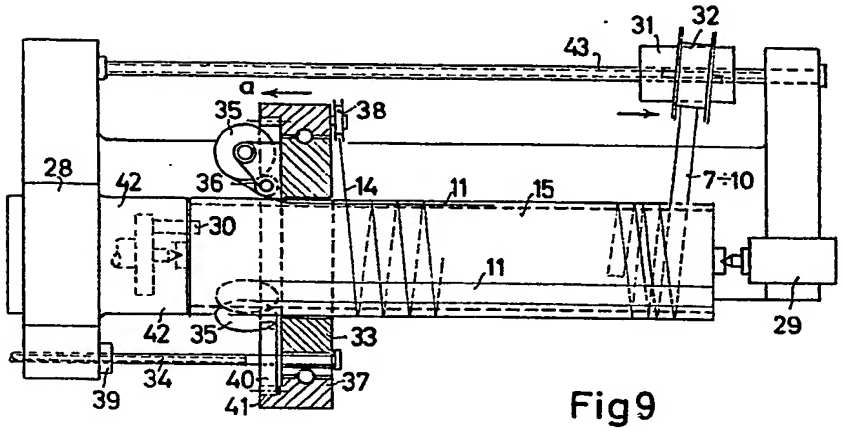

Fig9